Analyzing the Discourse of Learning: The Role of Transcript Analysis in Understanding Pedagogy in AI-Enhanced STEM Education

Category: Pedagogy | Published: January 27, 2026

Abstract

The integration of Artificial Intelligence in Education (AIEd) is rapidly transforming learning environments, particularly within Science, Technology, Engineering, and Mathematics (STEM) disciplines. While AI promises personalized learning paths, intelligent tutoring, and immersive simulations, a critical need exists to move beyond performance metrics and understand the pedagogical quality of interactions within these new ecosystems. This paper argues that transcript analysis, a well-established qualitative methodology, is an indispensable tool for this purpose. We provide a comprehensive overview of transcript analysis, beginning with its historical roots in the social sciences. The paper outlines the key theoretical frameworks that underpin its application in educational research, including sociocultural theory, constructivism, and the Community of Inquiry model. We then present a detailed examination of its contemporary applications in AI-enhanced STEM education, offering specific examples such as analyzing student dialogues with AI tutors, evaluating AI-supported collaborative learning, assessing reasoning in virtual simulations, and understanding how teacher pedagogy evolves with AI integration. Methodological considerations, including data collection, coding, reliability, and the emerging role of AI in automating analysis, are discussed. The paper argues that by systematically examining the discourse of learning, transcript analysis provides nuanced insights into how AI tools shape communication, scaffold knowledge construction, and impact pedagogical dynamics. These insights are crucial for the iterative design of more effective AIEd systems and for developing pedagogical strategies that leverage AI to foster deep and meaningful learning in STEM.

Introduction

The 21st-century educational landscape is being reshaped by the pervasive influence of artificial intelligence (AI) (Zawacki-Richter, 2019). In Science, Technology, Engineering, and Mathematics (STEM) fields, AI is not merely a subject of study but a powerful tool for teaching and learning (Boltsi, 2024). From intelligent tutoring systems that adapt to student needs to complex simulations that make abstract concepts tangible, AI applications hold the potential to revolutionize STEM pedagogy (Amdan, 2024; Sun, 2024). The rapid proliferation of these tools, however, has outpaced our understanding of their pedagogical impact. Evaluating the effectiveness of AI in education (AIEd) cannot be limited to measuring learning outcomes or system usage statistics. A deeper, more qualitative understanding is required to unpack the complex interactions between students, teachers, and AI agents.

The central challenge lies in opening the "black box" of the learning process within these technologically mediated environments. How does an AI tutor's feedback shape a student's problem-solving dialogue? How does an AI-powered simulation influence collaborative scientific inquiry? Answering these questions requires a methodology capable of capturing and interpreting the fine-grained details of communication and interaction. This paper argues that transcript analysis, a research method focused on the systematic examination of transcribed verbal data, is uniquely suited for this task. By analyzing the discourse that unfolds in AI-enhanced learning settings, researchers can gain profound insights into knowledge construction, pedagogical strategies, and the overall quality of the educational experience.

This paper will provide an initial exploration of transcript analysis as a vital research methodology for studying pedagogy in AI-enhanced STEM education. First, we will define the method and trace its historical development within the social sciences, carefully distinguishing it from the use of the same term in genetics and molecular biology. Second, we will discuss the core theoretical frameworks that inform its application in education. Third, we will detail its specific applications in the context of AIEd in STEM, providing concrete examples from intelligent tutoring, collaborative learning, and virtual simulations. Finally, we will address key methodological considerations and future directions, including the potential for AI itself to augment the process of transcript analysis. Ultimately, we contend that a rigorous application of transcript analysis is essential for ensuring that the design and implementation of AI in education are guided by sound pedagogical principles, a concept increasingly referred to as "pedagogical intelligence" (Díaz, 2024).

A History and Definition of Transcript Analysis in Educational Research

Defining the Method

In the context of educational and social science research, transcript analysis is the systematic, qualitative, and often quantitative examination of a textual representation of spoken or written communication. It is a method that transforms ephemeral verbal interactions into a stable dataset, or the transcript, that can be repeatedly scrutinized to uncover patterns, themes, structures, and meanings (Garrison, 2006). The resulting analysis can range from identifying broad themes in an interview to conducting a micro-level, turn-by-turn analysis of a classroom conversation.

Historical Development

The roots of transcript analysis in the social sciences are deep and interdisciplinary. Its development can be traced to several key intellectual movements of the 20th century.

1. **Linguistics and Anthropology:** Early ethnographic work in anthropology relied on detailed field notes and transcriptions of interviews and naturally occurring speech to understand culture. Linguistic anthropology, in particular, focused on how language use reflects and shapes social life, laying the groundwork for analyzing transcribed talk as cultural data.
2. **Sociology and Conversation Analysis (CA):** A major impetus came from the work of sociologists like Harvey Sacks, Emanuel Schegloff, and Gail Jefferson in the 1960s and 1970s, who founded Conversation Analysis. CA treats talk-in-interaction as a highly organized social activity. It uses meticulously detailed transcripts (often using the Jeffersonian system) to conduct micro-analyses of conversational structures like turn-taking, sequence organization, and repair mechanisms. This approach demonstrated that ordinary talk is systematically structured and worthy of rigorous scientific inquiry.
3. **Psychology and Discourse Analysis:** In psychology, the cognitive revolution's focus on internal mental processes was later complemented by a "turn to discourse." Psychologists began to analyze language not just as a window into the mind, but as a form of social action. Discourse analysis, influenced by thinkers like Michel Foucault, examines how language constructs versions of reality, establishes power relations, and shapes identities.

4. **Education Research:** In education, these traditions converged to create a powerful tool for studying teaching and learning. Researchers began recording and transcribing classroom interactions to understand everything from teacher questioning techniques to student collaborative problem-solving. The rise of online learning in the late 1990s and early 2000s provided a new, text-based source of data (e.g., discussion forums), making transcript analysis a cornerstone of research in computer-supported collaborative learning (CSCL) and distance education (Garrison, 2006).

The evolution of the method has also been shaped by technology. The laborious process of manual transcription and analysis has been increasingly supported by Computer-Assisted Qualitative Data Analysis Software (CAQDAS) like NVivo and ATLAS.ti (López, 2025). More recently, the advent of powerful AI language models has introduced the possibility of automating transcription and even preliminary coding, heralding a new phase in the methodology's history (Etesse, 2025).

Theoretical Frameworks Underpinning Transcript Analysis in Pedagogy

The power of transcript analysis lies not just in the method itself, but in the theoretical lenses through which the data are interpreted. Several key educational theories provide the foundation for analyzing learning discourse.

Sociocultural Theory: Rooted in the work of Lev Vygotsky, sociocultural theory suggests that learning is a fundamentally social process. Higher cognitive functions develop through interaction with more knowledgeable others within a specific cultural context. Concepts like the Zone of Proximal Development (ZPD), the space between what a learner can do alone and what they can achieve with guidance, are critical. Transcript analysis is the primary method for observing the ZPD in action. By analyzing dialogue between a student and a teacher, a peer, or an AI tutor, researchers can identify instances of scaffolding, where support is provided and gradually withdrawn, and internalization, where social speech becomes individual thought.

Constructivism: Constructivist theories argue that learners actively construct their own understanding and knowledge through their experiences and interactions with the world. Transcript analysis allows researchers to witness this construction process. In a collaborative STEM project, for example, analyzing student dialogue can reveal how they negotiate

meaning, challenge each other's ideas, resolve cognitive conflicts, and co-construct a shared understanding of a scientific concept. The transcript becomes a record of knowledge being built, not just transmitted.

Community of Inquiry (CoI) Framework: Developed specifically for online and blended learning environments, the CoI framework is a prominent example of a theory that relies heavily on transcript analysis (Garrison, 2006). The framework proposes that a meaningful educational experience requires the presence of three interdependent elements: social presence (the ability of participants to project themselves as 'real people'), cognitive presence (the extent to which learners are able to construct and confirm meaning through sustained reflection and discourse), and teaching presence (the design, facilitation, and direction of cognitive and social processes). Researchers use detailed coding schemes to analyze discussion forum transcripts, identifying indicators for each type of presence to evaluate the quality of the learning environment. This framework is directly applicable to analyzing interactions within AI-mediated platforms.

Discourse Analysis: Drawing from linguistics and critical theory, discourse analysis approaches examine how language is used to enact social and cognitive activities. For instance, James Gee's framework analyzes how individuals use language to build identities, relationships, and knowledge within specific "Discourses." In an AI-enhanced classroom, a discourse analysis of transcripts could reveal how the AI's communication style positions the student (e.g., as a novice, a partner, a recipient of information) and how this positioning affects their engagement and identity as a STEM learner.

These frameworks provide the conceptual tools to move from a simple description of what was said to a theoretically grounded interpretation of how learning is happening (or not happening) within an AI-enhanced educational setting.

Applications of Transcript Analysis in AI-Enhanced STEM Education

Transcript analysis provides a powerful lens for investigating the pedagogical dynamics of diverse AIEd applications in STEM. By capturing and dissecting the interactions that these tools generate, researchers can evaluate their design, understand their impact, and inform their improvement.

Analyzing Student-AI Tutor Interactions

Intelligent Tutoring Systems (ITS) and conversational agents are among the most common forms of AI in STEM education, promising personalized, one-on-one instruction (Gin, 2025). Transcript analysis of the dialogue logs between students and these systems is essential for understanding their pedagogical effectiveness. Researchers can analyze transcripts to:

- **Identify Misconceptions:** By examining the questions students ask and the errors they make in their typed responses, researchers can identify common conceptual hurdles in subjects like physics or algebra.
- **Evaluate Feedback Mechanisms:** Transcripts reveal how students respond to AI-generated feedback. Do they read it? Do they incorporate it into their next attempt? Is the feedback too generic or too prescriptive? Analysis can determine whether the AI is effectively scaffolding learning or simply providing answers.
- **Assess Natural Language Understanding:** The quality of the interaction often depends on the AI's ability to understand student input. Transcript analysis can pinpoint where the AI fails to interpret a student's question or statement correctly, leading to conversational breakdowns and frustration.
- **Map Problem-Solving Strategies:** By tracing the dialogue through a multi-step problem, researchers can analyze the student's reasoning process and how the AI tutor guides them toward a solution.

For example, a study might analyze the transcripts of high school students interacting with a chemistry chatbot. The analysis could code for types of student questions (e.g., definitional, procedural, conceptual) and types of AI responses (e.g., direct answer, Socratic questioning, hint). The findings could reveal that while the chatbot excels at definitional questions, it struggles to engage students in deeper conceptual reasoning, suggesting a need for redesign.

Evaluating AI-Supported Collaborative Learning

Collaboration is a critical skill in STEM, and AI is increasingly being used to support it. AI agents can act as moderators in online discussions, form optimal student groups, or provide real-time feedback on group processes. Transcript analysis of chat logs and audio recordings from these collaborative sessions is crucial for understanding the AI's impact.

- **Analyzing Group Dynamics:** Researchers can code transcripts for indicators of effective collaboration, such as equitable participation, building on others' ideas,

constructive conflict, and shared cognitive regulation. This allows for a comparison of group dynamics with and without AI support.

- **Measuring Quality of Discourse:** The analysis can focus on the scientific quality of the conversation. Are students using evidence to support their claims? Are they engaging in scientific argumentation? Are they co-constructing explanations? AI-powered tools can even be used to automatically code for these features in real-time (Li, 2022).
- **Assessing AI Interventions:** When an AI agent intervenes in a group discussion (e.g., by posing a question or highlighting a disagreement), transcript analysis can be used to study the immediate effect of that intervention. Did it deepen the conversation, or did it derail the students' train of thought?

Imagine a scenario where middle school students use a collaborative virtual environment to design a sustainable city. An AI facilitator monitors their chat. By analyzing the transcripts, researchers may find that the AI's prompts lead the conversations in specific directions. For example, the prompt "consider the environmental impact" may significantly increase the frequency of sustainability-related arguments and trade-off discussions among students.

Assessing AI-Powered Simulations and Virtual Environments

AI-driven simulations and virtual reality (VR) offer powerful platforms for experiential learning in STEM, from virtual patient encounters in medical education (Turner, 2025) to interactive physics labs. To understand the learning taking place, researchers often employ a "think-aloud" protocol, where students verbalize their thoughts as they interact with the simulation. These verbalizations are then transcribed and analyzed.

- **Revealing Clinical or Scientific Reasoning:** In a virtual patient simulation, a medical student's running commentary reveals their diagnostic reasoning, or how they interpret symptoms, what hypotheses they form, and why they order certain tests. Analyzing these transcripts provides a much richer assessment of clinical competence than simply scoring their final diagnosis (Pucchio, 2022).
- **Understanding Interaction with AI Characters:** Many simulations feature AI-powered non-player characters (NPCs). A recent study used transcript analysis to examine how pre-service teachers interacted with AI-powered "virtual students" (Zhang, 2024). The analysis of their talk moves revealed patterns in their pedagogical

approaches and highlighted difficulties in shifting from teacher-centered to more responsive teaching styles.

- **Identifying Usability Issues:** Think-aloud transcripts can also uncover usability problems with the simulation itself. Moments of confusion, frustration, or surprise expressed by the user can point to design flaws that hinder the learning experience.

Understanding Teacher Pedagogy with AI Tools

The introduction of AI tools into the classroom also changes the role of the human teacher. Transcript analysis of whole-class or small-group discussions where AI tools are being used can illuminate how teacher pedagogy is adapting.

- **Shifts in Classroom Discourse:** Researchers can compare transcripts from traditional lessons with those from lessons incorporating AI. Does the AI tool lead to more student-led inquiry and discussion? Does the teacher's role shift from being a "sage on the stage" to a "guide on the side"?
- **Teacher Scaffolding of AI Tools:** Transcripts can show how teachers introduce AI tools to students and how they scaffold their use. Do they model critical evaluation of AI-generated content? Do they encourage students to question the AI's output?
- **Teacher Perspectives:** Focus group interviews with teachers about their experiences with AI tools provide another rich source of data. Thematic analysis of these interview transcripts can reveal teachers' beliefs, concerns, and innovative practices related to AI integration (Bateman, 2024; Bai, 2023).

Methodological Considerations and Challenges

While powerful, the rigorous application of transcript analysis involves significant methodological considerations.

Data Collection and Transcription: The quality of the analysis depends entirely on the quality of the data. Researchers must make careful decisions about what to record (audio, video, screen capture) and how to transcribe it. A simple verbatim transcript may suffice for thematic analysis, but a micro-analytic approach like Conversation Analysis requires a detailed transcript capturing pauses, overlaps, and intonation. This process is time-consuming and requires trained transcribers. Ethical considerations, such as obtaining informed consent and ensuring participant anonymity, are paramount.

Coding and Reliability: The core of the analysis is the coding process, where segments of the transcript are labeled according to a predefined or emergent scheme.

- **Deductive vs. Inductive Approaches:** Researchers may use a deductive (top-down) approach, applying a pre-existing framework (like the CoI model) to the data. Alternatively, an inductive (bottom-up) approach, like grounded theory, allows themes and categories to emerge directly from the transcript data.
- **Inter-Rater Reliability:** To ensure the analysis is systematic and not merely subjective, multiple coders should independently analyze a subset of the data. Statistical measures like Cohen's Kappa are then calculated to assess inter-rater reliability. Disagreements are resolved through discussion, a process known as negotiated coding, which helps refine the coding scheme and ensure its consistent application (Garrison, 2006).

The Role of AI in Transcript Analysis: The intersection of AI and transcript analysis is twofold: AI is both the object of study and an emerging tool for analysis. AI offers significant opportunities to address some of the method's challenges, particularly its labor-intensive nature.

- **Opportunities:** AI-powered speech-to-text services can automate transcription with increasing accuracy. Natural Language Processing (NLP) techniques like topic modeling can perform initial explorations of large transcript datasets to identify key themes. Sentiment analysis can be used to gauge the emotional tone of a discussion (Casillano, 2024). Researchers are also developing systems where an AI evaluator bot reviews interaction transcripts against specific criteria, which can then be validated by human experts (Choo, 2025).
- **Challenges:** However, relying on AI for analysis is not without risks. Current AI models can struggle with the nuances of human conversation, such as sarcasm, irony, and context-dependent meaning. They may miss subtle pedagogical moves or misinterpret complex social dynamics. Furthermore, AI algorithms can reflect and amplify biases present in their training data (Pack, 2024). Therefore, the most promising approach involves a human-AI partnership, where AI tools are used to enhance and scale up the analysis, but human researchers retain the final interpretive authority (Etesse, 2025).

Discussion

The evidence presented underscores the indispensable value of transcript analysis for advancing research and practice in AI-enhanced STEM education. By moving beyond surface-level metrics, this methodology provides deep, qualitative insights into the pedagogical processes that underpin learning. The analysis of discourse allows us to understand *how* and *why* an AI tool is effective or ineffective, an understanding that is crucial for the iterative design of better educational technology.

Implications for AIEd Design and Pedagogy: The findings derived from transcript analysis have direct implications for creating more pedagogically intelligent AI systems (Díaz, 2024). If analysis reveals that an AI tutor's prompts are consistently leading to student confusion, the prompting algorithms can be redesigned. If transcripts from a collaborative platform show that certain students are dominating the conversation, the AI moderator can be programmed to encourage broader participation. This feedback loop between qualitative analysis and system design is essential for developing AI tools that are not just technologically sophisticated but also pedagogically sound.

Implications for Teacher Education and Professional Development: As AI becomes more integrated into classrooms, teachers need skills not only in using the technology but also in facilitating learning around it. Transcript analysis can be a powerful tool for professional development. Teachers can analyze transcripts of their own lessons to reflect on their practice, examining how their questioning changes when an AI tool is used or how they scaffold student interactions with AI. This reflective practice is vital for ensuring that human educators remain central to the learning process, a concern highlighted in the literature (Zawacki-Richter, 2019).

Limitations and Synergies: It is important to acknowledge the limitations of transcript analysis. The process is resource-intensive, and the findings from small-scale qualitative studies may not be generalizable. Furthermore, a transcript captures only the verbal dimension of an interaction, potentially missing important non-verbal cues or internal cognitive processes. For a more holistic understanding, transcript analysis should be integrated with other methods in a mixed-methods approach. For example, qualitative findings from transcript analysis can be triangulated with quantitative data on student performance, log data on system usage, and survey data on student perceptions (Zhang, 2024).

Conclusion and Future Directions

As artificial intelligence continues to permeate STEM education, the need for robust methods to evaluate its pedagogical value has never been more urgent. This paper has argued that transcript analysis, a methodology with a rich history in the social sciences, is a cornerstone of this endeavor. By enabling a systematic and theoretically grounded examination of the discourse of learning, it allows researchers, designers, and educators to look inside the black box of student-AI and student-student interactions. From assessing the scaffolding provided by an intelligent tutor to understanding the impact of an AI moderator on collaboration, transcript analysis provides the nuanced evidence needed to build more effective and equitable AI-enhanced learning environments.

The future of this research area is promising and points in several key directions. First, there is a need for more longitudinal studies that use transcript analysis to track the development of students' reasoning and communication skills over extended periods of interaction with AI systems. Second, the field should move toward more sophisticated multimodal analysis, integrating transcripts with other data streams like eye-tracking, gesture analysis, and physiological sensors to create a richer picture of the learning process. Third, the development of ethical and reliable AI-powered tools for transcript analysis must continue, with a focus on creating human-AI partnerships that can make this powerful methodology more scalable and accessible to a wider range of researchers and practitioners.

Ultimately, the goal of AI in education is not to replace human interaction but to enhance it. To achieve this, we must continue to listen closely to the conversations that unfold in our classrooms, whether they are physical, virtual, or a hybrid of the two. Transcript analysis is, and will remain, one of our most powerful tools for listening, understanding, and improving the future of learning.

References

Amdan, M, Janius, N, & Kasdiah, M (2024). Concept paper: Efficiency of Artificial Intelligence (AI) tools For STEM Education In Malaysia. International Journal of Science and Research Archive, 12(2), 553-559. https://doi.org/10.30574/ijsra.2024.12.2.1273

Bai, J, Marín, V, Jung, I, & Zawacki-Richter, O (2023). Future Prospects of Artificial Intelligence in Education: A Preliminary Analysis of Educator Perspectives from Focus Groups

in Japan, Spain, and Germany. Ubiquity Proceedings, . https://doi.org/10.5334/uproc.74

Bateman, T (2024). Teacher perspectives of ChatGPT as a pedagogical tool in the K-12 setting: a case study. Quality Assurance in Education, 33(2), 203-217. https://doi.org/10.1108/qae-02-2024-0042

Boltsi, A, Kalovrektis, K, Xenakis, A, Chatzimisios, P, & Chaikalis, C (2024). Digital Tools, Technologies, and Learning Methodologies for Education 4.0 Frameworks: A STEM Oriented Survey. IEEE Access, 12, 12883-12901. https://doi.org/10.1109/access.2024.3355282

Casillano, N (2024). Education in the ChatGPT Era: A Sentiment Analysis of Public Discourse on the Role of Language Models in Education. Journal Evaluation in Education, 5(4), 144-154. https://doi.org/10.37251/jee.v5i4.1151

Chiang, MK, & Melton, DA (2003). Single-cell transcript analysis of pancreas development. Developmental cell, 4(3), 383-93. https://doi.org/10.1016/s1534-5807(03)00035-2

Choo, S, Yoo, S, Endo, K, Truong, B, & Son, MH (2025). Advancing Clinical Chatbot Validation Using AI-Powered Evaluation With a New 3-Bot Evaluation System: Instrument Validation Study. JMIR nursing, 8, e63058. https://doi.org/10.2196/63058

Díaz, B, & Nussbaum, M (2024). Artificial intelligence for teaching and learning in schools: The need for pedagogical intelligence. Computers & Education, 217, 105071-105071. https://doi.org/10.1016/j.compedu.2024.105071

Etesse, M (2025). AI and Qualitative Data Analysis in Education Research: Familiarization and Exploration of Interview Transcripts Enhanced with ChatGPT. Smart innovation, systems and technologies, , 285-295. https://doi.org/10.1007/978-981-96-0426-5_24

Garrison, D, Cleveland-Innes, M, Koole, M, & Kappelman, J (2006). Revisiting methodological issues in transcript analysis: Negotiated coding and reliability. The Internet and Higher Education, 9(1), 1-8. https://doi.org/10.1016/j.iheduc.2005.11.001

Gin, BC, LaForge, K, Burk-Rafel, J, & Boscardin, CK (2025). Macy Foundation Innovation Report Part II: From Hype to Reality: Innovators' Visions for Navigating AI Integration

Challenges in Medical Education. Academic medicine : journal of the Association of American Medical Colleges, 100(9S Suppl 1), S22-S29. https://doi.org/10.1097/ACM.0000000000006117

Li, Z, Xie, H, Wang, M, Wu, B, & Hu, Y (2022). Automatic Coding of Collective Creativity Dialogues in Collaborative Problem Solving Based on Deep Learning Models. Lecture notes in computer science, , 123-134. https://doi.org/10.1007/978-3-031-08939-8_11

Lohar, DP, Sharopova, N, Endre, G, Peñuela, S, Samac, D, Town, C, Silverstein, KA, & VandenBosch, KA (2006). Transcript analysis of early nodulation events in Medicago truncatula. Plant physiology, 140(1), 221-34. https://doi.org/10.1104/pp.105.070326

López, V, Basantes-Andrade, A, Mejía, C, & Martínez, E (2025). The Impact of Artificial Intelligence on Inclusive Education: A Systematic Review. Education Sciences, 15(5), 539-539. https://doi.org/10.3390/educsci15050539

Pack, A, & Maloney, J (2024). Using Artificial Intelligence in TESOL: Some Ethical and Pedagogical Considerations. TESOL Quarterly, 58(2), 1007-1018. https://doi.org/10.1002/tesq.3320

Pertea, M, Kim, D, Pertea, GM, Leek, JT, & Salzberg, SL (2016). Transcript-level expression analysis of RNA-seq experiments with HISAT, StringTie and Ballgown. Nature protocols, 11(9), 1650-67. https://doi.org/10.1038/nprot.2016.095

Pucchio, A, Rathagirishnan, R, Caton, N, Gariscsak, PJ, Del Papa, J, Nabhen, JJ, Vo, V, Lee, W, & Moraes, FY (2022). Exploration of exposure to artificial intelligence in undergraduate medical education: a Canadian cross-sectional mixed-methods study. BMC medical education, 22(1), 815. https://doi.org/10.1186/s12909-022-03896-5

Sun, F, Tian, P, Sun, D, Fan, Y, & Yang, Y (2024). Pre-service teachers' inclination to integrate AI into STEM education: Analysis of influencing factors. British Journal of Educational Technology, 55(6), 2574-2596. https://doi.org/10.1111/bjet.13469

Trapnell, C, Hendrickson, DG, Sauvageau, M, Goff, L, Rinn, JL, & Pachter, L (2013). Differential analysis of gene regulation at transcript resolution with RNA-seq. Nature biotechnology, 31(1), 46-53. https://doi.org/10.1038/nbt.2450

Trapnell, C, Roberts, A, Goff, L, Pertea, G, Kim, D, Kelley, DR, Pimentel, H, Salzberg, SL, Rinn, JL, & Pachter, L (2012). Differential gene and transcript expression analysis of RNA-seq experiments with TopHat and Cufflinks. Nature protocols, 7(3), 562-78. https://doi.org/10.1038/nprot.2012.016

Turner, L, Kelleher, M, Overla, S, Zheng, W, Gregath, A, Gharib, M, Zahn, A, Santen, SA, & Weber, DE (2025). Harnessing the Generative Power of AI to Move Closer to Personalized Medical Education. Academic medicine : journal of the Association of American Medical Colleges, 100(12), 1447-1451. https://doi.org/10.1097/ACM.0000000000006185

Zawacki-Richter, O, Marín, V, Bond, M, & Gouverneur, F (2019). Systematic review of research on artificial intelligence applications in higher education – where are the educators?. International Journal of Educational Technology in Higher Education, 16(1). https://doi.org/10.1186/s41239-019-0171-0

Zhang, N, Ke, F, Dai, C, Southerland, S, & Yuan, X (2024). Seeking to support preservice teachers' responsive teaching: Leveraging artificial intelligence-supported virtual simulation. British Journal of Educational Technology, 56(3), 1148-1169. https://doi.org/10.1111/bjet.13522

© 2026, Dylan A. Bulseco, Ph.D., AI in Education Blog. All rights reserved.

This work is funded in part by NSF DUE 2300796, NSF ITE 2347375 and NSF DRL 2342700.